MOVE AZ
Long Range Transportation Plan

Appendix D. Performance Factors and Measures

MoveAZ Plan

prepared for

Arizona Department of Transportation

prepared by

Cambridge Systematics, Inc.

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ADOT

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Table of Contents

List of Tables

Introduction

This technical memorandum presents the performance measures selected by the Arizona Department of Transportation (ADOT) for use in the development of the MoveAZ plan. These measures were selected to identify and monitor performance and gauge the ability of proposed projects to satisfy ADOT's goals, which can be described by eight different performance factors:

1. Mobility;
2. Economic Competitiveness;
3. Connectivity;
4. Preservation;
5. Reliability;
6. Safety;
7. Accessibility; and
8. Resource Conservation.

The performance measures are organized according to the performance factors to which they apply (Mobility and Economic Competitiveness are grouped together, as performance measures for those factors apply to both). For each performance measure, a definition, a purpose, data sources, and a detailed example relevant to Arizona with calculations are presented.

In addition, this technical memorandum explains in general terms the scoring method for each measure to be used in assessing the system performance results of projects evaluated for the MoveAZ plan. During the analysis of existing conditions and future project evaluations, a more refined scoring method was developed for each performance measure (as documented in the Task 11, Project Evaluation Technical Memorandum). This scoring method considers specific statistical distributions among project scores for a specific measure, distribution of points among measures within a specific performance factor, and weighting of each performance factor.

Table 1, at the end of this technical memorandum, presents a summary of the supporting data, supporting tools, and expected output of each performance measure.

Performance Factor 1.0: Mobility and Economic Competitiveness

This factor uses two measures: 1) percent of person-miles traveled (PMT) by level of service (LOS) and 2) average delay per trip. The first gives a broad systemwide perspective of how much travel is occurring under congested (as well as free-flow) conditions. It provides a visual representation of system conditions by each functional class of roadway. The second measure describes how much extra travel time the average traveler spends to get to a given destination. It examines mobility from the user perspective, instead of the systemwide perspective.

Measure 1.1 – Percent of PMT by LOS

Definition: Percent of PMT occurring at different congestion levels, based on volume/capacity (v/c) ratio or LOS, and separated by functional classification. It can be calculated separately by rural or urban areas, as well as season. As the distribution becomes more skewed towards higher (better) LOS, conditions improve. For project comparison, an average v/c ratio weighted by PMT is reported; lower v/c is considered better. For each highway segment, the v/c was multiplied by the PMT. This product was summed for all segments in a district or across the entire state and divided by the total PMT in the district or state to generate a weighted v/c.

Purpose: This measure shows the percentage of passenger travel occurring under congested conditions. It can be calculated separately for rural or urban areas, or peak and off-peak tourist seasons, to ensure consistent and useful comparisons. Comparing this measure for different projects will show whether congested passenger travel increases or decreases, and by how much for each scenario. This measure can also show increases or decreases over time.

Data Sources: Data sources included geographic information system (GIS) layers, Highway Performance Monitoring System (HPMS), and regional agency data.

Example: The ADOT HPMS dataset provides mileage, average annual daily traffic (AADT), capacity, and v/c ratio for every link in the state highway system. Mileage and AADT are multiplied for every segment to find vehicle miles traveled (VMT), and VMT is in turn multiplied by the statewide average vehicle occupancy (and local vehicle occupancies for segments in the MAG and PAG regions) to generate PMT for every segment in the system. Segment PMT is summed across all rural and urban highways to find systemwide subtotal PMT for rural and urban segments. PMT is then summed across all highways in rural areas with an LOS of C or greater (defined by ADOT as a v/c ratio less than or equal to 0.70) and in urban areas with LOS D or better ($V/C \leq 0.80$). Dividing the latter by the former yields the percentage of PMT-rated LOS C (or D) or better systemwide in rural or urban areas, respectively.

Scoring: The project that causes the highest percent increase of PMT at or above LOS C (or D for urban areas) earns the maximum number of points for this measure. The lowest percent increase receives zero points. All other projects are scored proportionally within this scale.

Measure 1.2 – Average Delay Per Trip

Definition: Hours of extra travel time (defined as the total person-hours of travel less the total person-hours of travel at free-flow conditions) during a specified time period systemwide or in a particular ADOT district, divided by the average number of trips during that period. It can be calculated separately by season. As this measure decreases, conditions improve.

Purpose: This is a measure of congestion understandable by the general public. It can be used to compare alternative modal investments, and can be calculated separately for peak or off-peak tourist seasons. Comparing this measure by different project scenarios will show whether congestion increases or decreases. This measure can also show increases or decreases over time.

Data Sources: Supporting data included GIS layers, HPMS, and national trip and trip length data.

Example: The existing HPMS dataset – the "base case" – is input into the Highway Economic Requirements System (HERS), which subsequently calculates the systemwide delay in hours per 1,000 VMT. This gross number is divided by the number of average daily person trips, determined in Arizona through trip length data from the National Personal Transportation Survey (NPTS) and other national data, to arrive at the delay per trip. A modified HPMS dataset, which accounts for projects with changes in capacity, speed, functional class, and other design elements contained in HPMS fields, is then input into HERS to identify the change in delay.

Scoring: The project that decreases the average delay per trip the most receives the highest number of points for this measure; the project that decreases it the least receives zero points. All other projects are scored proportionally within this scale.

■ Performance Factor 2.0: Connectivity

The two connectivity measures consider the availability of efficient highway connections between Arizona cities and towns, particularly in more rural areas of the State. The first measure evaluates connectivity through the presence of passing ability along two-lane state highways; and the second evaluates the circuitousness and travel time of existing routes in selected high-priority corridors through the potential for decreasing the shortest travel time in those corridors.

Measure 2.1 – Passing Ability

Definition: This measure calculates a volume to service ratio for current two-lane facilities in Arizona. The service volume is calculated based on percent trucks, terrain, and the percent of lanes striped for passing. A decrease in the ratio is considered beneficial. This measure is based on the passing lanes methodology developed by ADOT in its Passing Lanes/Climbing Lanes report.

Purpose: This measures intercity connectivity by indicating a necessity for multi-lane highway segments, passing lanes, or climbing lanes. Projects that straighten curves, level terrain, or add passing lanes should all produce positive changes in this measure.

Data Sources: The data sources used to support this measure included GIS layers, HPMS, the ADOT Passing Lanes/Climbing Lanes report, and Highway Capacity Manual (HCM) methods.

Example: Only two-lane segments are evaluated for this process. The HPMS dataset provides data on the number of lanes on any highway segment, the percent of each segment that allows passing, percent trucks on the segment, and the v/c ratio. The percent passing ability is adjusted using thresholds established by ADOT for level, rolling, and mountainous terrain. A project that adjusts any of these parameters will change the passing ability.

Scoring: The project which provides the largest percent increase in passing ability within a district or the state as a whole receives the maximum amount of points for this measure. A project that widens a highway from two to four lanes will show a 100 percent improvement for that segment of the corridor. Projects that provide no increase in this measure receive zero points. All other projects are ranked proportionally within this scale.

Measure 2.2 – Intercity Travel Time Connectivity

Definition: Travel time savings as reported in one of the 1994 High-Priority Corridors, identified in the 1994 Long-Range Transportation Plan.

Purpose: To measure the potential for improvement in the shortest travel time between Arizona cities. This measure aids in comparing needs for decreased travel times in important corridors.

Data Sources: Data included GIS layers, HPMS, and the 1994 Long-Range Transportation Plan.

Example: ADOT GIS layers provide city locations, as well as state highways. Applicable city pairs are identified using these layers. The HPMS dataset provides data on the functional classification and speed of every highway segment. The GIS highway layer and HPMS layer are joined to establish the route length of the state highway routes in each corridor, and to identify the shortest travel time in each corridor using speed limits. The

GIS layers also determine the straight-line distance between the two cities in each corridor. The interstate speed limit (65 mph) is applied to find the straight-line theoretical travel times. The two travel times in each corridor are subtracted to find the difference between the theoretical fastest travel time and the actual shortest state highway travel time.

Scoring: This measure evaluates projects on a corridor level. The project which provides the largest percent decrease in the shortest travel time within a corridor receives the maximum amount of points for this measure. Projects which provide no decrease in this measure receive zero points. All other projects are ranked proportionally within this scale.

■ Performance Factor 3.0: Preservation

ADOT uses pavement and bridge management systems to determine future pavement and bridge conditions, and how to program resources for repairs and replacement. The preservation performance measures presented below are applied to projects and data output from these management systems. As pavement and bridge maintenance and construction are funded separately within ADOT, only the first measure – Reconstruction Need – is currently used for project selection. However, it is only a temporary measure that will be replaced by the other measures described in this section when ADOT's new pavement management system is operational.

Measure 3.1 – Reconstruction Need

Definition: Average number of years since last roadway reconstruction by roadway segment, as indicated by the ADOT Pavement Management System (PMS), weighted by average AADT. This measure considers old segments in need of total reconstruction, with an average year of last reconstruction before 1970.

Purpose: To evaluate projects that do not affect roadway capacity, but improve deteriorating roadways.

Data Sources: Supporting data included HPMS and ADOT PMS information.

Example: A hypothetical project under evaluation will reconstruct a 10-mile segment of I-40. According to the ADOT PMS, the last reconstruction of this segment was 1965 (averaged by mile) – 37 years ago relative to the current year (2002). The average AADT along this segment is 25,000 vehicles. 25,000 is divided by 1,000 and added to the age of the roadway, yielding a value of 62.

Scoring: The reconstruction project for a segment of roadway with the highest average value for this measure receives the maximum points. The reconstruction project for a segment of roadway with the lowest value receives zero points. All other projects are scored proportionally within this scale.

Measure 3.2 – Pavement Condition

Definition: Percent of state highway lane miles by pavement condition, as rated in the ADOT Pavement Management System, reported by functional classification. This pavement serviceability rating (PSR) scale has five categories, ranging from "very poor" (0) to "excellent" (5). It can be calculated separately for rural and urban areas. As the distribution becomes more skewed towards higher pavement conditions ("moderate" to "excellent"), conditions improve. For project comparison, the average PSR will be reported: a higher number indicates an improvement.

Purpose: The percent of pavement by each rating provides information on the condition of ADOT state highway surfaces. Comparing this measure for different projects will show whether overall pavement conditions improve, and by how much for each project. This measure can also show changes in the percent of pavement in each condition over time. The overall systemwide PSR is reported for comparison to the recommended target of 3.27.

Data Sources: Data used to support this measure was obtained from the ADOT PMS.

Example: The ADOT PMS user defines a system goal, such as a maximum of 20 percent of roadways to be rated "bad," or a budget of $25 million. The PMS outputs recommended projects and the resulting PSR for every highway segment. For each functional classification, the miles per segment are multiplied by the PSR for that segment, the products are summed together, and they are divided by the total functional class mileage to find the average PSR.

Scoring: The project (or programming scenario) that causes the greatest percent increase in average PSR receives the maximum number of points for this measure. A project that results in a zero percent increase receives zero points. All other projects are scored proportionally within this scale.

Measure 3.3 – VMT by Pavement Condition

Definition: Percent of VMT on state highways by pavement condition, as rated in the ADOT Pavement Management System, reported by functional classification. This scale has five categories, ranging from "very poor" (0) to "excellent" (5). Can be calculated separately by rural or urban areas. As the distribution becomes more skewed towards higher pavement conditions ("fair" to "excellent"), conditions improve. For project comparison, the percentage of VMT on pavement rated "good" (PSR of 3.1) or better will be reported: a higher number indicates an improvement.

Purpose: The percent of VMT on pavement by each rating provides information on the condition of ADOT state highway surfaces, and what percentage of travelers is experiencing each level of pavement. This measure is similar to Measure 3.1, but applies more weight to heavily traveled roadways. Comparing this measure for different projects will show whether overall pavement conditions improve, and by how much for each project. This measure can also show changes in the percent of pavement in each condition for the most heavily traveled roadways over time.

Data Sources: Data sources and tools used to support this measure included the ADOT PMS, HPMS, and HERS.

Example: Output from a PMS programming scenario (for example, a budget of $25 million) with suggested projects and refined PSR ratings is linked to the HPMS dataset. The corresponding VMT generated from HPMS for all highway segments now ranked "good" or better (3.1 or greater) are added together, the total systemwide VMT is calculated, and the two are divided to find the percent of VMT on pavement ranked "good" or better.

Scoring: The project (or programming scenario) that results in the largest percent increase of VMT on state highway lane-miles at or above "good" receives the maximum number of points for this measure. The project that results in the lowest percent system increase for this measure receives zero points. All other projects are scored proportionally within this scale.

Measure 3.4 – Bridge Condition

Definition: Number or percentage of deficient bridges on state routes, as rated in the ADOT Bridge Management System (BMS), separated by functional class of roadway. This is a seven-point rating for four different bridge components in accordance with National Bridge Inventory (NBI) reporting standards, with seven being excellent. It can be calculated separately by rural or urban areas. The percentage of deficient bridges is defined as the deck area of bridges with one or more deficient components (rated four or less) divided by the total deck area in the bridge inventory. A lower number indicates an improvement.

Purpose: The number of bridges rated at each sufficiency rating provides information on the condition of ADOT state bridge conditions. Comparing this measure for different projects will show whether overall bridge conditions improve, and by how much for each project. This measure can also show changes in the number of bridges in each condition over time.

Data Sources: Data supporting this measure were obtained from the ADOT BMS.

Example: The ADOT BMS outputs the rating of each of four components for every bridge on the state transportation system. It also contains data on the deck area of each bridge and the functional classification of roadway it connects. For each functional classification, the deck areas of all bridges with one component rated four or less are added together, the total deck area of all bridges found, and the two are divided to find the percentage of deficient bridges on that functional class.

Scoring: The project (or programming scenario) that results in the largest decrease in deficient bridges receives the maximum number of points for this measure. The project that results in the lowest system value for this measure receives zero points. All other projects are scored proportionally within this scale.

Measure 3.5 – Vehicle Trips by Bridge Condition

Definition: This measure computes the annual number and percentage of vehicle trips on deficient bridges, as rated in the ADOT BMS. It considers a seven-point rating for four different bridge components in accordance with NBI reporting standards, with 7 being excellent. It can be calculated separately by rural or urban area. A deficient bridge is defined as a bridge with one or more deficient components (rated four or less). A lower number indicates an improvement.

Purpose: The percent of vehicle trips on bridges at each sufficiency rating provides information on the condition of all bridges on the state transportation system and the percentage of travelers experiencing each bridge condition level. This measure is similar to Measure 3.4, but applies more weight to heavily traveled roadways. Comparing this measure for different projects will show whether overall bridge conditions improve, and by how much for each project. This measure can also show changes in the percent of bridges for each condition level for the most heavily traveled roadways.

Data Sources: Data used to support this measure included ADOT BMS and HPMS.

Example: The ADOT BMS database of bridges (for the "base case") contains detailed information on the condition of each bridge and the traffic volumes using each bridge. The AADTs on bridges with one component rated four or below are added together, the total AADT is summed across all bridges, and the two are divided to identify the percentage of vehicle trips on deficient bridges.

Scoring: The project (or programming scenario) that results in the largest percent decrease of vehicle trips on deficient bridges on state highways receives the maximum number of points for this measure. The project that results in the lowest percent increase for this measure receives zero points. All other projects are scored proportionally within this scale.

■ Performance Factor 4.0: Reliability

Measure 4.1 – Additional Unexpected Delay

Definition: Incident-related non-recurring delay per VMT on the state highway system, based on methodology used in HERS. As this measure decreases, reliability improves.

Purpose: This measure provides a sense of how variable travel times are for an entire district or state, due to non-recurring incident delay. It can be used to compare modes, alternatives, and seasonal values for different project scenarios.

Data Sources: The data and tools used to support these measures included HPMS and HERS.

Example: The existing HPMS dataset – "base case" – is input into HERS, which subsequently calculates the systemwide incident-related delay in hours per 1,000 VMT. A modified HPMS dataset, which accounts for projects with changes in capacity, speed, functional classification, and other design elements contained in HPMS fields, is then input into HERS to compute the change in total incident-related delay.

Scoring: For this measure, it is necessary to know the base conditions for the year in which projects are being compared. In the list of projects being compared in Task 11, the project that results in the lowest non-recurring delay per VMT for the system receives the maximum number of points for this measure, and sets the maximum for the point scale. The value below, which will receive zero points for this measure, is determined through a statistical analysis procedure. All other projects are scored proportionally within this scale.

■ Performance Factor 5.0: Safety

The safety performance factor includes two performance measures: 1) accidents per million VMT by functional class, and 2) anticipated reduction in fatalities and injuries. The first is a normalized rate that accounts for more driving in future years: as VMT increases, the absolute number of accidents will likely increase, though the accident rate may stay the same or decrease. The second measure focuses on identifying specific locations that have a high absolute number of accidents.

Measure 5.1 – Accidents Per 100 Million VMT by Functional Class

Definition: Accidents on state highways, separated by accidents with fatalities or injuries, divided by 100 million VMT on those highways, distributed by functional classification. A decrease indicates an improvement in safety among that functional classification.

Purpose: This measures the number crashes by functional classification, divided by the traffic on a roadway. Indexing the number of accidents to 100 million VMT normalizes the effect of population and economic growth. Stratifying this measure by functional classification allows ADOT to evaluate information for different categories of roadway, and to consider geometric design, access, and speed limit issues and their effect on safety.

Data Sources: Data and tools used to support this measure included HPMS, GIS layers, ADOT accident database, and HERS.

Example: To establish the base conditions of accidents per million VMT by functional class, the ADOT accident database is used to determine the number of accidents on each roadway. The roadways are then cross-referenced with the Arizona Transportation Information System (ATIS) GIS state highway layers – which contain fields for both roadway names and functional classification – to determine the functional classification of each roadway in the accident database. Accidents are finally summed by each functional classification. Using total VMT by functional classification data, available from the HPMS dataset, each number of accidents is divided by the corresponding million VMT.

The existing HPMS dataset – the "base case" – is input into HERS, which subsequently calculates estimated accident rates per 100 million VMT, by functional classification. A modified HPMS dataset, which accounts for projects with changes in capacity, speed, functional classification, and other design elements contained in HPMS fields, is then input into HERS to see the new accident rates. Finally, the differences in rates between the two HERS runs are applied to the actual ADOT accident rates by functional classification.

Scoring: The project which decreases the overall accident rate by the largest percentage is assigned the full amount of points for this measure. The value below which will receive zero points for this measure is determined through a statistical analysis procedure. All other projects are scored proportionally within this scale.

Measure 5.2 – Anticipated Change in Fatalities/Injuries

Definition: This measure computes the anticipated percent change in fatalities and injuries from accidents. A lower percent change indicates an improvement in safety.

Purpose: This measure assesses at the actual number of fatalities and injuries reduced, not just the number of accidents reduced. It is useful for identifying significant accident reductions at high accident locations.

Data Sources: Data and tools used to support this measure included HPMS, GIS layers, and HERS.

Example: The existing HPMS dataset – the "base case" – is input into HERS, which calculates estimated annual systemwide fatality and injury rates per 100 million VMT. A modified HPMS dataset, which accounts for projects with changes in capacity, speed, functional classification, and other design elements contained in HPMS fields, is then input into HERS to see the change in accident rates. Finally, the differences in rates between the two HERS runs are multiplied by the total systemwide VMT – available from the HPMS dataset and also output by HERS – to find the change in fatalities and injuries. The percent change is also calculated.

Scoring: The project with the greatest percent reduction in fatalities and injuries is assigned the full amount of points for this measure. The value below which will receive zero points for this measure is determined through a statistical analysis procedure. All other projects are scored proportionally within this scale.

Performance Factor 6.0: Accessibility

The following measures examine accessibility to non-auto travel modes, as well as high-occupancy vehicle (HOV) travel. These measures are used to assess the elements of HOV, bus, and bicycle transportation over which ADOT has direct jurisdiction and control.

Measure 6.1 – Park-and-Ride Spaces

Definition: This measure computes the number of park-and-ride spaces adjacent to state highways. An increase indicates an improvement in park-and-ride accessibility.

Purpose: This measure focuses on actions that can be taken directly by ADOT to improve access to the state transportation system by means other than construction of new roadways or reconstruction of existing roadways. These actions help to promote carpooling and, therefore, increase vehicle occupancy, decrease VMT, decrease total fuel consumption, and decrease system wide emissions.

Data Sources: ADOT information on existing park-and-ride spaces and GIS layers was used to support this measure.

Example: A proposed project along U.S. 60 near Power Road in Mesa will construct a park-and-ride lot with a total of 800 new spaces.

Scoring: A project that adds park-and-ride spaces receives the maximum number of points for this measure. Projects with zero added spaces receive zero points.

Measure 6.2 – Bus Turnouts

Definition: This measure computes the number of bus turnouts on state highways with transit or school bus service. An increase indicates an improvement in bus transit accessibility.

Purpose: This measures accessibility to public transportation for individuals near state highways were transit service already exists, as well as accessibility and safety for school children. It focuses on actions that can be taken directly by ADOT to improve access to the state transportation system by means other than construction of new roadways or reconstruction of existing roadways.

Data Sources: ADOT information on existing bus turnouts and GIS layers were used to support this measure.

Example: Currently, no projects exist on the state transportation system which specifically mentions the construction of bus turnouts. As a result of the inclusion of this measure in the MoveAZ plan, projects that include bus turnouts (and that specifically mention their inclusion) will score favorably.

Scoring: In the list of projects being compared, those that add bus turnouts receive the maximum number of points for this measure. Projects with zero added turnouts receive zero points.

Measure 6.3 – Bike Suitability

Definition: Percent of state routes or state route miles that are more bike suitable, based on ADOT definitions of bike suitability in the recently completed Bicycle/Pedestrian Plan. Bike suitability is a function of percent trucks, v/c ratio, shoulders, and the speed limit. Urban interstates, freeways, and expressways are always considered "unsuitable." Current law also does not permit bicycles on Interstate 10 between Tucson and Phoenix, rendering this segment unsuitable. An increase indicates an improvement in bicycle accessibility. Measured systemwide.

Purpose: It focuses on actions that can be taken directly by ADOT to improve access to the transportation system by means other than construction of new roadways or reconstruction of existing roadways.

Data Sources: Data used to support this measure included GIS layers, HPMS, and the ADOT Bicycle/Pedestrian Plan.

Example: Based on the ADOT GIS layer of bicycle suitability, 28.7 percent of the state highway system are considered suitable, with 17.2 percent specifically more suitable. A hypothetical series of projects will repave U.S. 60 from I-10 in Guadalupe to Apache Junction and add significant shoulder width, moving it into the "more suitable" category. According to the project definition, this project improves 27 miles of U.S. 60. Adding 27 miles to the total "more suitable" highway miles, a recalculating yields 17.6 percent: a systemwide increase of 0.4 percent.

Scoring: In the list of projects being compared, the one which increases the systemwide bike suitability by the greatest percentage receives the maximum number of points for this measure. Projects that do not improve bicycle suitability receive zero points. All other projects are scored proportionally within this scale.

Performance Factor 7.0: Resource Conservation

The first measure evaluates mobile source emissions for transportation projects. This is a standard environmental measure that examines systemwide environmental performance, as well as the environmental impact in areas where air quality is already a critical concern. The second measure – percentage of air quality improvement projects selected – is a function of the first measure: any project that reduces mobile source emissions is considered an "air quality project." It serves as a screen to apply preference to projects that reduce emissions. The third measure evaluates highway noise exposure of residential areas. The fourth measure evaluates coordination between the MoveAZ plan and regional plans, ensuring that transportation (and, indirectly, land-use) decisions are consistent across different tiers of government. The final measure looks at conservation of fuel due to both changes in fleet fuel economy and direct changes in the transportation system made by ADOT.

Measure 7.1 – Total Mobile Source Emissions

Definition: This measure computes total tons of mobile source emissions. It can be calculated separately by rural or urban areas. A decrease in this measure indicates a positive change.

Purpose: This measure gauges the impact of transportation system usage on the environment by tracking the total Nitrogen Oxide and Volatile Organic Compound emissions related to transportation.

Data Sources: The data and tool used to support this measure included GIS layers, HCM, HERS, and MOBILE6 emission rate data.

Example: The MOBILE6 emissions calculation software is used to establish emission rates by emission type, vehicle (auto or truck), and speed. Using HCM equations by functional classification of roadway and v/c ratio data in HPMS, the average speed of every highway segment is calculated in mph. The speed on each segment is matched to the appropriate emissions total from the lookup table (hydrocarbon, carbon monoxide, and nitrous oxide). Finally, this emissions number on each segment is multiplied by the total VMT on that segment, and those products summed across the entire system to get total grams (reported in metric tons) of mobile source emissions.

Scoring: In the list of projects being compared, the one which results in the lowest total mobile source emissions for the system receives the maximum number of points for this measure. The value below which will receive zero points for this measure will be determined through a statistical analysis procedure. All other projects are scored proportionally within this scale.

Measure 7.2 – Percentage of Air Quality Improvement Projects Selected

Definition: This measure considers the annual percentage of transportation air quality improvement projects that are incorporated in the MoveAZ plan. An air quality improvement project is defined as any project which, when implemented, will result in an improvement from base conditions for Measure 7.1. A higher number indicates an improvement for this measure.

Purpose: This is a screening measure that is applied after the selection of projects to report the percentage of projects that have a positive impact on air quality. This measure is not used for individual project selection – Measure 7.1 fulfills that purpose for the Environmental Protection performance factor. This measure reports only one number, which can be compared to percentages of other years' project selection lists or to other packages of projects.

Data Sources: The results of Measure 7.1 and data from the GIS layers, HERS, and various ADOT project study reports were used to support this measure.

Example: The existing HPMS dataset – the "base case" – is used to calculate systemwide mobile source emissions as outlined in the example for Measure 7.1. A project that increases emissions is not an "air quality improvement project." Five modified HPMS datasets are created, each one accounting for a different potential project in the same designated package of projects. After each has its v/c ratios, average speeds, corresponding pollution rate, and total mobile source emissions recalculated as part of Measure 7.1, three result in total mobile source emissions that are less than the "base case," one results in a system increase, and one results in no change in emissions. Three of the five projects in this package, therefore, are "air quality improvement projects": this measure's value for the project package is 60 percent.

Scoring: A value of 100 percent receives the maximum number of points for this measure. A value of zero percent receives zero points. All other packages are scored proportionally within this scale.

Measure 7.3 – Noise Exposure

Definition: This measure computes the number of state highway miles with sound walls. An increase in this measure indicates a positive change.

Purpose: This measure is an indication of how much the disruption of the environment around existing or proposed transportation infrastructure can be mitigated. Transportation projects that build sound walls will have an effect on this measure.

Data Sources: Data such as GIS layers and the ADOT current sound wall location data were used to support this measure.

Example: A proposed freeway extension through a residential community in the Phoenix area also has a sound wall as part of the programmed project.

Scoring: A project that includes a sound wall receives the maximum number of points for this measure. Projects without sound walls receive zero points.

Measure 7.4 – Projects Listed in Regional Transportation Plans

Definition: Projects recommended for the MoveAZ plan that are also listed in regional transportation plans (RTPs). An increase in this measure indicates a positive change.

Purpose: This measures coordination between ADOT – through the MoveAZ plan – with regional and local entities, and encourages mutually beneficial policies. This measure can be used as an "all or nothing" screen, reported as a percentage to be compared between project packages, or reported as an overall total percentage to be compared over time.

Data Sources: Data sources included the RTPs conducted across the State and the proposed MoveAZ plan project list.

Example: A sample project being selected for the MoveAZ plan to add a new park-and-ride lot in Mesa is also included in the MAG RTP. A hypothetical project proposed by ADOT will add a bus turnout along U.S. 60 in Mesa. However, this project was not previously included in the MAG RTP. These projects are being grouped together for analysis as one project package. This project has a value of 50 percent, as one-half of the projects in this package are also listed in RTPs.

Scoring: This measure either is or is not fulfilled by each project: if the project is also in an RTP, then it receives the full points for this measure. If it is not, then it receives zero points.

Measure 7.5 – Fuel Consumption

Definition: This measure computes the number of gallons of fuel consumed. Calculations of future year values will be separated by changes due to variations in fleet fuel economy and changes due to modifications by ADOT. Can be calculated separately by urban or rural areas. A decrease in this measure indicates a positive change.

Purpose: This measures systemwide fuel consumption over time or for individual projects. Changes in fuel consumption due to variations in fleet fuel economy are calculated separately to ensure that this measure indicates changes in fuel consumption as a result of changes in the transportation system by ADOT (i.e., changes that reduce VMT).

Data Sources: Data included GIS layers, HCM methods, HPMS, and Intelligent Transportation System Deployment Analysis System (IDAS) fuel consumption rates.

Example: IDAS provides lookup tables for fuel consumption rates in gallons per mile. These tables are a function of speed, functional class, and vehicle type (auto or truck).

Using HCM equations by functional classification of roadway and v/c ratio data in HPMS, the average speed of every highway segment is calculated in mph. Based on the appropriate HCM equation and the given free-flow speed, the current average speed is calculated. HPMS indicates the percentage of total AADT that are trucks. IDAS assumes an even split between diesel and gasoline trucks, and that assumption is applied here. The resulting AADTs are multiplied by the length of the highway segment to find VMT. For the calculated average speed, the IDAS lookup table indicates fuel consumption rates per VMT for autos, gasoline trucks, and diesel trucks, respectively. Finally, each rate is multiplied by its corresponding VMT to yield gallons of fuel consumed per day.

Scoring: The project that results in the largest percent decrease in fuel consumption for the system receives the maximum number of points for this measure. The value below which will receive zero points for this measure is determined through a statistical analysis procedure. All other projects are scored proportionally within this scale.

Table 1. Performance Measure Data, Tools, and Outputs

Performance Measure	Supporting		Expected Outputs
	Data	**Tools**	
Percent of PMT by LOS	Volume, capacity, roadway miles, route coverage	GIS, HPMS, urban models	System, district, and project – Congestion by functional class
Average Delay per Trip	Volumes, travel speeds, trip lengths, route coverage	GIS, HPMS	System and district – Hours of congestion delay
Passing Ability	Terrain type, truck %s, two-lane roadway miles, % miles striped for passing, volumes	GIS, HPMS	System, district, and project – Percent change in deficient state highway miles
Intercity Connectivity	Speeds, route distances, route locations	GIS, HPMS	System, district, and project – Percent change in travel time
Reconstruction Need	Date of reconstruction, volumes	HPMS, PMS	Project – Average age, weighted by volume, of roadway to be reconstructed
Pavement Condition	Pavement serviceability ratings	PMS	System – Percent of highway miles by pavement condition rating and functional class
VMT by Pavement Condition	Volumes, pavement serviceability ratings	PMS, HPMS, HERS	System – Percent of VMT on highway by pavement condition rating and functional class
Bridge Condition	Bridge sufficiency ratings, bridge coverage	BMS, Pontis	System number of deficient bridges by functional class
Vehicle Trips by Bridge Condition	Volumes, bridge sufficiency ratings, bridge coverage	BMS, Pontis, HPMS	System – Annual and percentage of vehicle trips on deficient bridges by functional class

Table 1. Performance Measure Data, Tools, and Outputs (continued)

Performance Measure	Supporting Data	Supporting Tools	Expected Outputs
Additional Unexpected Delay	Volumes, roadway mileage, ADOT incident data	HPMS, HERS	System – Travel time variability due to non-recurring incident delay by functional class
Accidents per 100 Million VMT by Functional Class	ADOT accident data, volumes, roadway mileage, route coverage	HPMS, GIS, HERS	System, district, and project – Change in accident rates by type and by functional class
Anticipated Change in Fatalities/ Injuries	ADOT accident data, volumes, roadway mileage, route coverage	HPMS, GIS, HERS	System, district, and project – Change in accidents by type and functional class
Park-and-Ride Spaces	Number of park and ride spaces, route coverage	GIS	System, district, and project – Park-and-ride spaces adjacent to highways
Bus Turnouts	Number of bus turnouts, route coverage	GIS	System, district, and project – Bus turnouts adjacent to highways
Bike Suitability	% trucks, volume, capacity, shoulder data, speeds	GIS, HPMS	System, district, project – Percent of bike suitable highways by functional class
Total Mobile Source Emissions	VMT and route coverage by functional class, emissions rates	GIS, HERS, MOBILE6	System – Total tons of emissions by functional class
Percentage of Air Quality Improvement Projects Selected	MoveAZ project list, RTPs, route coverage, output from emissions measures	GIS, HERS	System, district, and project – Number of air quality improvement projects
Noise Exposure	Sound wall locations	GIS	System and project – Sound walls added by proposed projects
Projects Listed in Regional Transportation Plans	MoveAZ project list, RTPs, route coverage	GIS	System and district – Number of state system projects identified by regional agencies
Fuel Consumption	Fleet size changes, VMT, speeds, route coverage, fuel consumption rates	GIS, IDAS	System and project – Changes in fuel consumption

Source: Cambridge Systematics, Inc., and Lima Associates, 2003.